SEAWOLF SSN 21 CLASS ATTACK SUBMARINE AND AN/BSY-2 COMBAT SYSTEM

Navy ACAT IC Program

Total Number of Systems:	3
Total Program Cost (TY$):	$13185M
Average Unit Cost (TY$):	$2828M
Full-rate production:	N/A

Prime Contractor

General Dynamics Electric Boat Division-SSN 21
Lockheed Martin-AN/BSY-2 (V)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The SEAWOLF (SSN 21) Nuclear Attack Submarine was developed to maintain the U.S. technological lead in undersea warfare well into the 21st century. It is designed to rapidly deploy to militarily important hostile ocean areas and deny their use to the enemy, clear the way for strikes by other friendly forces, and engage and destroy enemy submarines, surface forces and land targets, supporting ***dominant maneuver*** as well as ***full-dimensional protection*** for afloat forces. Secondary missions are mine and special warfare. SSN 21 is designed to be a quiet, fast, heavily armed, shock resistant, survivable submarine, outfitted with the AN/BSY-2 Submarine Combat System.

The AN/BSY-2 Submarine Combat System is designed to support SSN 21 in all mission areas. It is required to track targets, platforms, and weapons. These characteristics will provide intelligence and

strike capabilities to support the Joint Force Commander in ***precision engagement*** as well as provide ***full-dimensional protection***. The combat control subsystem provides setting and control of weapons and mines, over-the-horizon targeting, combat systems management, and piloting and navigation functions. It includes the weapon launch equipment to support eight horizontal tubes, a vertical large screen display, and own ship data displays. More specific information is included in the classified version of this report.

BACKGROUND INFORMATION

The SSN 21 program began in 1982 and was approved for conceptual design in 1983. In December 1983, the preliminary design was authorized; it was completed in 1985. Approval for lead ship production was granted in 1988.

The DAB ADM for the SSN 21 Program Review decision of January 11, 1991, approved continuation of LRIP through completion of OT in FY98 (now scheduled for FY00). DOT&E's input to that decision was based upon an independent evaluation and assessment of projected performance of SSN 21. DOT&E identified several important aspects of performance without which SSN 21 may not achieve and retain the advantage over the projected threat. A detailed discussion of these aspects was published in the classified FY90 edition of this report. Performance changes due to programmatic changes to supporting systems are discussed in the FY95 Annual Report.

SSN 21's initial sea trials were delayed by concerns about the robustness of the titanium used in some of SEAWOLF's watertight integrity applications. This was partially resolved and SEAWOLF began initial sea trials in July 1996. On her second trial, a casualty to the Wide Aperture Array (WAA) sonar fairing occurred. The corrective action delayed delivery until mid-1997. Following delivery, USS SEAWOLF began acoustic trials, which were completed in November 1997.

The SSN 21 Live Fire Test and Evaluation (LFT&E) program began on August 16, 1988 when the Secretary of Defense directed the Secretary of the Navy to provide an LFT&E plan to OSD. The Navy LFT&E Plan for SEAWOLF, dated September 21, 1988, featured component and surrogate shock tests and most significantly, a *full ship shock test (FSST) of the completed ship*. Component and surrogate shock tests included underwater explosion tests with major SEAWOLF components installed realistically in large-scale surrogate test vehicles exposed to full design shock levels. DOT&E approved the latest LFT&E strategy, shown in the SEAWOLF TEMP in February 1999.

A summary of SEAWOLF LFT&E activity includes a test in 1990 of a 1/4 scale Shock Model Test Vehicle that underwent underwater shock and hull whipping. A/B-1 tests were conducted in 1995 with shock testing of a surrogate Main Propulsion Unit (MPU) and the WAA sonar fairing. An A/B-1 underwater shock test series of major hull penetrations and related components was conducted at the Aberdeen Test Center in 1998-1999. Testing of smaller hull penetrations has been performed using the Navy's Full Scale Section (FSS-5 and FSS-8) shock test vehicles and Paddlewheel shock test fixture. Extensive shock qualification testing of SEAWOLF internal vital components has been accomplished using Floating Shock Platforms (test barges) and standard Navy shock test machines. As of July 2000, approximately 5,662 SEAWOLF components had been shock qualified, with 700 remaining to be qualified, including some major components such as the Main Propulsion Unit (MPU).

In 1993, as part of its LFT&E program, the Navy developed the "SEAWOLF Program Manager's Plan for Countering Secondary Casualties", associated with secondary weapons effects. Secondary

weapons effects are those effects subsequent to initial damage, such as fire, smoke, toxic gases, and flooding.

Congress appropriated funds in FY96 to conduct the FSST, which is the capstone test for certifying combat ruggedness of the ship class. The Navy instead elected to use those funds to help pay for correction of unforeseen problems with the fairing to the ship's WAA sonar. The Navy rescheduled the FSST to FY00 and programmed additional funds to support FSST, but Congress, over DOT&E objections, explicitly removed the FY99 funds allocated for preparations for an FY00 FSST. The Navy has since deleted all SEAWOLF FSST funding from the Navy Future Years Defense Plan.

SEAWOLF spent FY98 in post-delivery shakedown, and then spent FY99 completing a post-shakedown availability (PSA) at Groton, CT. SEAWOLF is currently undergoing Operational Evaluation (OPEVAL) and concurrently preparing for her first major deployment, scheduled to occur in 2001. CONNECTICUT (SSN 22) began sea trials in September 1998, and spent FY99 in post-construction shakedown, entering drydock for PSA in September 1999. CONNECTICUT completed PSA in November 2000 and is now participating in the SEAWOLF class OPEVAL. The third and final SEAWOLF class submarine, JIMMY CARTER (SSN 23), is under construction with delivery scheduled in FY04. JIMMY CARTER will be uniquely outfitted with an additional hull section lengthening the ship for special missions and R&D projects.

TEST & EVALUATION ACTIVITY

DOT&E approved Change 1 to Revision 4 to the TEMP in October 2000. This change aligned initial and follow-on operational testing consistent with agreements reached between the Navy and DOT&E. This realignment has supported the Navy's desire to deploy SEAWOLF as soon as possible by initially testing only those mission profiles that SEAWOLF is expected to use during her initial deployment. Other mission profiles, including Battlegroup Operations, Special Warfare, and Under-ice Operations will be tested before the ship is employed tactically in those mission profiles. Follow-on operational testing will also be needed to assess planned propulsor and sonar improvements.

SEAWOLF completed Acoustic Trials with her anechoic coating installed (December 1999), Hydrodynamic Trials (March 2000), Weapons Systems Accuracy Trials (March 2000), and Launcher Trials (April 2000). SEAWOLF partially completed Target Strength Trials in November 1999. The BSY-2 Combat System Technical Evaluation (TECHEVAL) was completed in October 2000.

In March 2000, the Navy distributed its report of the 1998-1999 A/B-1 underwater shock test series. Lessons learned from this A/B-1 test series are discussed below. The Navy is preparing a Vulnerability Assessment Report (VAR), as required by the current TEMP LFT&E Strategy, that will provide an overall assessment of the ship's vulnerability to threat weapons that may be encountered in combat. The VAR is to be completed in FY01. A draft version was to have been provided to DOT&E for comment by October 2000, but as yet has not been received. An Independent Vulnerability Assessment will be performed by DOT&E in FY01 after receipt of the Navy's VAR.

The SEAWOLF class OPEVAL is in progress. OPEVAL consists of four phases: Cold Water Operations, Warm Water Operations, Strike Warfare, and Minefield Operations. OPEVAL includes assessment of the SEAWOLF class for mission effectiveness and operational suitability across the spectrum of it warfighting capabilities, except for Battlegroup Operations, Under-ice Operations, and Special Warfare. Both SEAWOLF and CONNECTICUT are participating in various phases of the OPEVAL.

TEST & EVALUATION ASSESSMENT

The FY 96, 97, 98, and 99 Annual Reports chronicle numerous disruptions in the SEAWOLF program which have resulted in delays to the SEAWOLF Test Program, and hence the ship's initial deployment. Some of these delays also interrupted funding for the FSST when the Navy used funds budgeted for the FSST to correct emergent problems to the ship's flank sonar array support structure. Congress then refused again in FY99 to fund the FSST, a move that Navy and DoD acquisition executive leadership accepted, citing the small size of the SEAWOLF class (3 ships), similarities in construction to the LOS ANGELES class, and unnecessary cost. The Navy has also argued that its component shock qualification program and design modeling are sufficiently robust to assure a survivable end product. DOT&E views the Navy arguments against conducting the FSST as untenable due to the advanced design of SEAWOLF, her unique weapons suite, her combat system, her size and her speed. Furthermore, the impact on ship and crew survivability is unknown.

In FY00, several significant equipment/design problems caused disruptions in SEAWOLF's test program, delaying OPEVAL by four months. The BSY-2 TECHEVAL, planned to be completed by May 2000, did not complete until October 2000, caused by failure of a TB-29 towed array, repeated failure of the TB-29 towed array handling mechanism, and uncertainties in the sonar system's ability to automatically track some important submarine target frequencies as designed. Another problem, discussed in the classified version of this report, delayed a live Tomahawk test missile firing from July 2000 to a now-scheduled February 2001 date. SEAWOLF also required drydocking from August to September 2000 to confirm acceptable weld integrity in SEAWOLF's high pressure spherical air flasks. These air flasks are part of SEAWOLF's emergency main ballast tank blow system that is used for rapid surfacing in the event of an emergency, most notably flooding. The welds had come under scrutiny after unacceptable weld defects were detected in two spare air flasks, which the Navy was preparing for component shock qualification testing. To the Navy's credit, component shock qualification testing is continuing to be pursued on SEAWOLF, but this late-emerging problem also underlined that the SEAWOLF component shock qualification program is incomplete, something DOT&E has reported the past several years.

Although the Navy has not gone on record to agree to complete OPEVAL before the ship's initial deployment, its actions to date have supported conducting the OPEVAL before SEAWOLF initially deploys. To help complete OPEVAL, DOT&E has supported test sharing between both SEAWOLF and CONNECTICUT. DOT&E's position continues to be that OPEVAL should be completed and its results promulgated before SEAWOLF's initial fleet deployment in 2001.

In FY99, DOT&E received and analyzed SEAWOLF's pre-PSA acoustic trial report and reported findings in last year's report. SEAWOLF's post-PSA acoustic trial was completed in November 1999, but the Navy did not grant DOT&E analysts access to trials data until late September 2000. Analysis is in progress.

Suitability issues of availability and logistics supportability remain unresolved due to late funding for critical spares and limited fiscal resources for engineering support and correction of major material deficiencies. Many SEAWOLF parts are already out of production, exacerbating this situation. SEAWOLF's maintenance will be expensive even if reliability goals are met.

A November 1999 COMOPTEVFOR Operational Assessment report cited six critical operational issues as high risk for SEAWOLF. These were (1) covertness, (2) weapon launch, handling,

and stowage, (3) detection, (4) tactics, (5) survivability, and (6) enhanced modular signal processor. The survivability risk is attributed to the lack of understanding caused by the absence of the FSST, and COMOPTEVFOR recommends conducting this test. COMOPTEVFOR also notes that there have been numerous failures in component-level shock tests. Once those failures have been corrected, a full ship shock test is justified to examine interfaces between components and system-of-systems issues. DOT&E agrees with this assessment, and notes that most of these concerns have been articulated to varying degrees in this report for the past several years. The Navy has plans in place to alleviate these risks in the long term, with the exception of ship and crew survivability. More details are provided in the classified version of this report.

DOT&E believes that omission of the FSST places SEAWOLF's combat survivability in question. Ship shock tests have historically revealed serious, but correctable, design deficiencies that component testing, modeling, simulation, or analysis alone did not detect. For example, the A/B-1 shock test series identified shock deficiencies, confirmed corrective actions, and provided valuable lessons learned for major hull penetrations. One of the major purposes the FSST serves is to provide some reasonable degree of assurance that all components acting together as a system-of-systems perform satisfactorily when exposed to weapons effects likely to be experienced in combat. Another major purpose of the FSST is to help validate computer models used in analysis for shock qualification of major systems such as the MPU. The approach for Verification, Validation, and Accreditation (VV&A) has not been described for models used in support of LFT&E. The FSST has long been the centerpiece of the SEAWOLF TEMP LFT&E strategy that had been mutually agreed upon by the Navy and DOT&E and is essential to a meaningful vulnerability assessment. To date, the Navy has proposed no alternative approach for developing the vulnerability-related information that an FSST would provide.

The Navy is preparing a VAR that will provide an overall assessment of the ship's vulnerability to threat weapons that may be encountered in combat. LFT&E Issues to be addressed include the ship's vulnerability to torpedoes and mines, and the ship's ability to perform its mission after exposure to specified levels of underwater shock intensity. The Navy's report will be based on tests and analyses that have been conducted, but the Navy will not be able to address the LFT&E Issues properly without the benefit of a completed FSST. Without an FSST, the overall SEAWOLF LFT&E program will be incomplete and inadequate. Major aspects of the survivability of the ship will be unknown.

The JIMMY CARTER (SSN 23) design is substantially different from the SEAWOLF (SSN 21) configuration with upgrades that may significantly affect survivability. In addition to lengthening the hull by approximately 100 feet and adding nearly 2500 tons displacement, other modifications include changes to the pressure hull, adding a dry deck shelter, inserting an ocean interface section as well as installation of numerous new systems that should be shock qualified. Therefore, on December 2, 1999, DOT&E designated JIMMY CARTER as a covered product improvement program on the LFT&E oversight list. A new TEMP including a new LFT&E Strategy is required. The Navy has not yet agreed to provide a new TEMP and LFT&E Strategy as requested by DOT&E. DOT&E memorandum to Assistant Secretary of the Navy Research, Development, and Acquisition (ASN (RDA)) dated July 17, 2000 reemphasized the need for a new TEMP and LFT&E Strategy.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

SEAWOLF is a major defense acquisition program, so DOT&E will assess OT and LFT adequacy, evaluate operational effectiveness, suitability, and survivability, and submit final test and evaluation reports to Congress as required by Sections 2366 and 2399, title 10, U.S. Code. DOT&E maintains that assessment of operational effectiveness, suitability, and survivability must precede the

decision to operationally employ the SEAWOLF Class During FY00 the Navy has indicated through its actions that it is supporting this course of action. In FY01, DOT&E will continue to work with the Navy to address any emergent scheduling challenges.

DOT&E believes that the Navy must report on the completeness of the SEAWOLF component shock qualification program, and ensure all major components are shock qualified before the ship deploys. This is particularly important since the FSST remains unfunded, and the Navy has argued that its "robust" component shock qualification program is a major justification for not performing the FSST.

The Navy is short of serviceable TB-29 towed arrays. More details are provided in the classified version of this report. It is recommended that the Navy fully budget and the Congress fund all needed TB-29 procurements.

As COMOPTEVFOR recommends, the Navy should budget for and the Congress should fully fund the SEAWOLF class FSST, even if it would now occur after the ship's initial deployment. Furthermore, Congress should remove its restrictions on the conduct of the SEAWOLF FSST. Live fire testing of platforms such as SEAWOLF reveal deficiencies that were previously undetected, but are relatively easily corrected, and will protect the crew during battle. Although the Navy has resisted shock testing SEAWOLF (on the argument of excessive cost versus the small number of hulls), it has agreed to perform the test if it is funded. DOT&E considers the $47 million price tag reasonable when viewed in the much larger context of SEAWOLF's overall cost and added crew safety margin.

The A/B-1 testing experience has demonstrated a particular benefit of the Aberdeen Test Center's Underwater Test Facility. When conducting a long duration test series that would not be feasible or cost effective at sea, the A/B-1 test series enabled the identification of shock deficiencies and subsequent development, incorporation, and successful testing of related design changes, confirming a satisfactory correction of the shock deficiencies. The Navy has assured DOT&E that it intends to implement the design changes developed through A/B-1 testing in all SEAWOLF Class submarines. Shock testing can uncover weaknesses in the design of vital components having major significance in the submarine's function and ability to survive in combat. Such weaknesses in many instances are not costly to correct. Based on this test and similar experiences on USS JACKSONVILLE (SSN 699), similar significant weaknesses affecting the submarine's ability to complete its mission would be uncovered in a SEAWOLF FSST.

Per DOT&E guidance, the Navy should also provide a new TEMP LFT&E Strategy for JIMMY CARTER (SSN 23) to describe the approach for addressing the impact on her survivability of the major modifications being installed in that ship.

The cost cap, which served its purpose to rein in cost growth, continues to adversely impact the future operational effectiveness of the ship since planned enhancements have had to be delayed or scrapped. Cost pressures have also led to the delay or cancellation of important tests. More details are provided in the classified version of this report. Funding these improvements are becoming even more important as total submarine force levels decline.

Unanticipated problems arise in any acquisition program, and in a technologically complex program such problems are to be expected. The difficulty with a fairing on the ship's flank sonar array led first to the delay, and eventually the cancellation of SEAWOLF's FSST. The SEAWOLF program and other Navy programs need to prevent emergent difficulties that arise in one area from canceling important tests in other areas.

Over the years, the Navy has operationally evaluated its submarine sonars and combat systems, but the SEAWOLF OPEVAL is the first-ever ***independent*** look at a US nuclear submarine. This is also the first look at the capabilities of our nuclear attack submarines (*including* VIRGINIA) for the next 25 to 40 or more years. This presents a unique opportunity to identify VIRGINIA problems early, during the SEAWOLF OPEVAL, helping make the VIRGINIA and all the new attack submarines of its class better submarines. Finally, the SEAWOLF needs to be operationally evaluated to better understand her capabilities before she initially deploys as a front-line fleet asset for reasons cited in this report. A better picture of SEAWOLF's effectiveness, particularly when compared to previous U.S. submarines, should emerge after OPEVAL.